2.3 Other Sources of Energy:

2.3.1 Diesel Generating Sets:

As Back up supply, there are two **DG Sets** of 100 KVA and 82.5 KVA in the premises. The 82.5KVA DG set is not in operation and is lying unconnected.

The 100 KVA DG set is used only for the Light and Fan (and not Power) Electrical Load of Administrative building. The same supply is sometimes used for the internal functions of the BOU as well.

The 100 KVA DG Set is of Kirloskar Make, Bhaskar Model, 3 Phase, with noise limit of < 75 db (A) at 1 meter.
82.5 KVA DG set is also of the same specifications.

It is informed by the Electrician BOU, who is maintaining DG sets also, that the hourly consumption of diesel for 100 KVA DG set is around 11 Lt/hr. But since there is no log of units generated or the diesel consumption, the efficiency of DG set could not be ascertained.

Energy Meter is installed at 100 KVA DG set outgoing but periodic log of units generated or Diesel Consumption is not maintained. Record of running hours of DG set and procurement of Diesel is properly maintained.

It is learnt that inspection of officials of MP Electrical Inspectorate is also due for 2-3 years. The Electricity Duty on the units generated by DG set is also not being paid to Government of MP.

2.3.2 Solar Power:

There are **Solar Panels of 100 Kw** installed in the premises. These are 300 Panels of 320 W Pmax, installed by MP Urja Vikas Nigam Ltd under 'Grid Connected Roof Top Solar Project'. The solar panels were commissioned on 15.09.2018. The project cost was Rs.58,27,605/-

The Solar Panels are of Adani make – Mundra Solar PV Ltd., Kutch, Gujarat. Each plate is of 320 Watt Max Power, with Open Circuit Voltage of 45.5 V and Power Current of 8.9 Amp, Weight 22 Kg and Application Class is 'A'.

There are 2 Inverters of Sungrow make, Model SG50CX

The rated output power of each inverter is 50 KW, Maximum Input Voltage is 1100 Volts DC and the Output Voltage is 3 Phase 400 / 230 V, 83.6 Amp

The Power supply of Solar is connected with the Grid Supply at the Electric Panel of Administrative Building.

Secure make Energy meter, S. No.X1068170 is installed at the roof top of administrative building. The units of Solar Generations are being adjusted in the monthly HT Electricity Bills.

2.3.3 Water:

Water is another secondary source which is being used for drinking, and horticulture purpose

There are 2 No. Tube wells for catering to drinking and residential use of water.
The main pump is of 3 HP installed near the administrative building and the other pump of 1.5 HP is installed near Sump well and Pump House. The main 3 HP pump runs for around 18 hours a day; morning 10 am to 4 pm and then from 6 pm to next day 6 am. The 1.5 HP pump has low water level and is run intermittently for around 2-3 hrs during working hours from 8 am to 4 pm.

The water from these tube wells is pumped in to a Sump Well, in front of Pump House. The capacity of sump well is 1.5 Lakh Lt. From this sump well, the water is pumped to different water storage tanks installed at the roof top of all the buildings like administrative building, Guest House, Quarters, Bungalows, Blocks etc.

The water is pumped through 3 Mono Block pumps. At present one pump of 5 HP and one pump of 3 HP are in operation. One pump of 3 HP is out of order.

There are two 2 HP tube wells also, located at the front garden of the administrative building. These tube wells are used for the gardening purpose.

2.4 POWER SUPPLY ARRANGEMENT:

For Transformer 1, the main LT cable is of 3-1/2 core 300 sqmm size terminating in to an Outdoor Distribution panel installed inside the Sub Station compound. From this panel, there are 5 No. 3-1/2 core 185 sqmm cables emanating.

One Cable is terminating at EMPRC Block Electric Panel.

The other 4 cables are reaching to a Panel Room adjacent to the DG Room. Out of this one cable is terminating at the Electric panel for administrative building, one cable is terminating at electric panel of EMPRC block and the remaining two cables are lying unconnected and are as stand by.

The Power Supply from Solar is also connected with the Grid supply at the Electric panel for administrative building.

The administrative block electric panel is actually two ways. Main panel caters to Power Load of the Administrative Block while the Light & Fan Loads are catered through a separate electric panel, which also have power supply from the 100 KVA DG set. 3-1/2 core 150 sqmm cable is used for power circuit and 4 core 16 sqmm cable is used for Lighting circuit.

Normally the MCB of DG set incomer is kept off and Light & fan power to administrative building is catered through Discom grid supply. In case of power failure from grid, the grid MCB is switched off and DG Incomer is switched ON and power is restored.

There is no proper manual changeover supply system between the MP MK VV CL Grid Power and DG set supply.

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For Transformer 2 also, the main LT cable is of 3-1/2 core 300 sqmm size terminating in to an Outdoor Distribution panel installed inside the Sub Station compound. From this panel, there are 3 No. 3-1/2 core 185 sqmm cables emanating.

One of the cables is terminating at the Electric Panel of Material Store.

The other two cables are terminating at a pole with two overhead LT Circuits. One of the LT feeder feeds to the Electric panel of employee's quarters and the other LT circuit is terminating at electric panel of Officer's residential block. In between this circuit feeds to VC Bungalow and Street Lights as well.

2.5 USES OF ENERGY IN THE PREMISES:

The electricity is used in the University premises for the following purposes:

- For Light & Fan of administrative building, which houses offices, class rooms, library etc, and the cooling / heating inside the University building.
- Computers, Printers, Photocopy machines and other similar office equipment.
- Water coolers
- Water Pumps
- Boundary / Street Lights (for night lighting)
- Guest House and Residential Purpose
- Gardening & Horticulture

2.6 FIRE FIGHTING ARRANGEMENT:

There are adequate arrangements of fire fighting with hand operated fire extinguishers.
6 No. 4.5 Kg CO2 type fire extinguishers are for electric substation and electric panel rooms and DG Room.
Around 39 No. 5 Kg ABC Powder type fire extinguishers are for other areas of administrative building, Guest House, EMPRC Block and Material store.

2.7 ELECTRICAL CONNECTED LOAD OF THE PREMISES:

The audit team has visited every room, library, offices, library, corridors of the building and counted the electrical load. The electrical load counting of residential blocks and bungalows is not done from inside field visit.

The main electrical load of the premises is, Light and Fan Loads which includes Tube Lights, CFLs, LEDs, Fans, Exhaust fans, Computers, printers etc. These buildings have low electrical load equipment and are in bulk and some of the rooms are found locked during inspection. The focus of load counting is on high consumption electrical loads and the quantity mentioned may vary with-in permissible limit. The slight variation in the quantity would in no way going to impact the result of the audit.

The equipment-wise electrical load of the University campus integrated from different sections of the premises, as per Field inspection is tabulated as below:

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i. **Administrative Building**

This is the main building of the premises and houses all the Class rooms, Library and Offices. It has 3 floors – G +2. Each floor has 3 wings – A, B & C.

It gets power supply from Transformer 1 and from DG Set. There are 7 DBs on each floor; 2 for A wings, 3 for B wings and 2 for C wings. From here the power is distributed to respective Switch Boards / Sections. Power and Lighting DBs are separate. Lighting DB is catered through DG set as backup supply. The DBs at Ground Floor have separate earthing pits and the earth wire runs from this GF DB for First and Second floor respective DBs.

It has two lifts. During audit, one of the lifts is not operating.

Administrative Building			
Electric Load	– Qty (No.)	Unit Load (Kw)	Total Load (Kw)
Air Conditioner 1.5 T	30	2.20	66.00
Air Cooler	15	0.30	4.50
Water Cooler	3	0.75	2.25
Photocopy Machine	7	1.50	10.50
Room Heater / Convector	35	2.00	70.00
Lifts	2	5.50	11.00
Miscellaneous Load (Light, Fan and Computers etc)	LS	LS	35.75
Total Load			**200**

ii. **EMPRC Block**

EMPRC Block			
Electric Load	– Qty (No.)	Unit Load (Kw)	Total Load (Kw)
Air Conditioner 1.5 T	2	2.20	4.40
Projector	1	1.50	1.50
Miscellaneous Load (Light, Fan and Computers etc)	LS	LS	4.10
TOTAL		**KW**	**10.00**

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iii. D Type Bunglows

D Type Bunglows			
Electric Load	**~ Qty (No.)**	**Unit Load (Kw)**	**Total Load (Kw)**
Air Conditioner 1.5 T	3	2.20	6.60
Fridge	1	0.50	0.50
Geyser	2	2.00	4.00
Coolers	3	0.30	0.90
Kitchen Equipment	LS	LS	4.00
Miscellaneous Load (Light, Fan, TV and Computers etc)	LS	LS	4.00
Total		**KW**	**20.00**
Total for 2 Bunglows	**2**	**20.00**	**40.00**

iv. E & F Type Flats – 4 Blocks, 11 Flats in 1 Block

E & F Type Flats			
Electric Load	**~ Qty (No.)**	**Unit Load (Kw)**	**Total Load (Kw)**
Air Conditioner 1.5 T	1	2.20	2.20
Fridge	1	0.50	0.50
Geyser	1	2.00	2.00
Coolers	2	0.30	0.60
Kitchen Equipment	LS	LS	4.00
Miscellaneous Load (Light, Fan, TV and Computers etc)	LS	LS	2.70
Total		**KW**	**12.00**
Total for 44 Flats	**44**	**12.00**	**528.00**

i. G & H Type Quarters – 1 BHK Type, 45 No.s

G & H Type Quarters			
Electric Load	**~ Qty (No.)**	**Unit Load (Kw)**	**Total Load (Kw)**
Fridge	1	0.30	0.30
Geyser	1	2.00	2.00
Coolers	1	0.30	0.30
Kitchen Equipment	LS	LS	2.00
Miscellaneous Load (Light, Fan, TV and Computers etc)	LS	LS	2.40
Total		**KW**	**7.00**
Total for 45 Quarters	**45**	**7.00**	**315.00**

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Guest House – 9 Rooms

Guest House			
Electric Load	- Qty (No.)	Unit Load (Kw)	Total Load (Kw)
Air Conditioner 1.5 T	9	2.20	19.80
Geyser	9	2.00	18.00
Kitchen Equipment	LS	LS	5.00
Miscellaneous Load (Light, Fan, TV and Computers etc)	LS	LS	10.20
Total		KW	53.00

i. Material Store

Material Store			
Electric Load	- Qty (No.)	Unit Load (Kw)	Total Load (Kw)
Miscellaneous Load (Light, Fan, TV and Computers etc)	LS	LS	5.00
Total		KW	5.00

i. Miscellaneous

Miscellaneous Loads			
Electric Load	- Qty (No.)	Unit Load (Kw)	Total Load (Kw)
Street Lights - LED	20	0.08	1.60
Sodium Vapour	40	0.15	6.00
Tube Well	1	2.25	2.25
	1	1.15	1.15
Sump Well	1	3.75	3.75
	2	2.25	4.50
Garden Tube well	2	1.50	3.00
SBI ATM	LS		5.00
Other Un accounted	LS	LS	3.75
Total		KW	31.00

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i. Total Estimated Connected Load of the premises

The Total estimated connected electrical load of the premises is 1,182 KW. The Load Centre-wise details are as below:

Total Estimated Connected Load of the premises	
Load Centre	Total Load (Kw)
Administrative Building	200
EMPRC Block	10
D Type Bunglows	40
E & F Type Flats	528
G & H Type Quarters	315
Guest House	53
Material Store	5
Miscellaneous Load	31
TOTAL	1,182

2.8 DETAILS AND ANALYSIS OF ELECTRICITY BILLS:

The Electricity Bill details of last one year have been tabulated in a specific format, for analysis. The period of consideration is from Dec 2021 to Nov 2022.

Month	Units Consumed (KWh)	Solar Units Export	Net Units Billed	Maximum Demand	Billing Demand	Load Factor	Power Factor	Current Electricity Bill	Electricity Rate
	Total	KwH	KWh	KVA	KVA	%	%	Rs	Rs / KWh
Dec-21	19,916	1,484	18,432	98.52	180	14	72.84	2,58,257	14.01
Jan-22	26,267	839	25,428	91.56	180	17	97.87	2,18,381	8.59
Feb-22	18,561	2,607	15,954	89.76	180	11	96.22	2,14,524	13.45
Mar-22	12,576	4,859	7,717	51.72	180	6	95.37	2,09,334	27.13
Apr-22	22,148	2,438	19,710	89.40	180	13	98.20	2,16,369	10.98
May-22	26,525	1,133	25,392	95.52	180	17	98.86	2,60,457	10.26
Jun-22	26,129	1,091	25,038	101.64	180	16	99.14	2,56,686	10.25
Jul-22	19,353	1,283	18,070	75.24	180	12	96.72	2,09,096	11.57
Aug-22	14,700	1,800	12,900	48.12	180	9	93.96	1,70,066	13.18

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Month	Units Consumed (KWh)	Solar Units Export	Net Units Billed	Maximum Demand	Billing Demand	Load Factor	Power Factor	Current Electricity Bill	Electricity Rate
	Total	KwH	KWh	KVA	KVA	%	%	Rs	Rs / KWh
Sep-22	14,669	2,748	11,921	46.20	180	8	94.49	2,11,702	17.76
Oct-22	13,334	4,991	8,343	53.64	180	6	86.80	2,23,122	26.74
Nov-22	12,302	4,713	7,589	61.32	180	5	82.03	2,24,215	29.54
Total Annual	**2,26,480**	**29,986**	**1,96,494**					**26,72,209**	
Monthly Average	**18,873**	**2,499**	**16,375**	**75.22**	**180**	**11**	**92.71**	**2,22,684**	**16.12**

- The average annual expenditure on electricity bills is Rs. 26.72 Lakh (~ monthly expenditure Rs. 2.23 Lakh)
- Annual consumption is 2.26 Lakh units ~ monthly consumption of 18,873 Units.
- Annual Generation of Electricity from 100 Kw Solar Plant is 29,986 Units which is equivalent to 2,499 Units per Month ~ 83 Units per Day

  Considering that the Units generated from solar plant is of the order of 4 Units per day per Kw, it can be concluded that the ***Solar Plant is underutilised or is operating at very low efficiency.***
- Accordingly **Net Energy Billed Units** after subtracting Solar Generated Units are 1.96 Lakh Unit `~ 16,375 Units per Month
- **The average cost of electricity is Rs. 16.12 Unit.** (On Net Energy Units Billed)
- The average Power Factor of the premises is 92.71%. ***This is appreciable.***

  (Power Factor (PF) is a technical term, which can be brought up to 1.0 by suitable corrective means. Low PF attracts penalty from the Utility.)
- The premises has the Contract Demand with MP MK VV CL for 200 KVA while the average Monthly demand for the period from Dec 2021 to Nov 2022 is just 75.22 KVA against the minimum Billing Demand of 180 KVA

  The customer has to pay minimum demand (90% of the Contract Demand, which is 180 KVA in this case, on which the electricity charges are required to be paid.
- The Load Factor of the premises is just 11% against the total estimated connected load of 1,176 KW.

  Load Factor = Monthly Consumption / (720 X PF X Billing Demand)

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- Considering the Maximum Demand as just 75 KVA and Load Factor as 11 %, it is concluded that the ***consumer is paying excessively on account of Fixed Charges associated with the Contract and Billing Demand.***

Month	Net Units Billed	Maximum Demand	Billing Demand	Power Factor	Power Factor Surcharge	ToD Rebate	Electricity Duty	Surcharge on Arrears	Current Electricity Bill
	KWh	KVA	KVA	%	Rs	Rs	Rs	Rs	Rs
Dec-21	18,432	98.52	180	72.84	39,448	-11,278	20,404	3,113	2,58,257
Jan-22	25,428	91.56	180	97.87	-5,737	-13,205	28,683		2,18,381
Feb-22	15,954	89.76	180	96.22	-2,399	-11,745	17,996	2,695	2,14,524
Mar-22	7,717	51.72	180	95.37	-580	-6,190	8,705		2,09,334
Apr-22	19,710	89.40	180	98.20	-7,452	-8,540	22,356		2,16,369
May-22	25,392	95.52	180	98.86	-9,662	-9,570	28,985		2,60,457
Jun-22	25,038	101.64	180	99.14	-13,338	-8,757	28,581		2,56,686
Jul-22	18,070	75.24	180	96.72	-2,765	-6,770	20,735		2,09,096
Aug-22	12,900	48.12	180	93.96		-5,732	14,803		1,70,066
Sep-22	11,921	46.20	180	94.49		-5,584	13,679		2,11,702
Oct-22	8,343	53.64	180	86.80	1,940	-3,528	9,699		2,23,122
Nov-22	7,589	61.32	180	82.03	6,470	-6,023	8,822		2,24,215
Total Annual	1,96,494				5,925	-96,922	2,23,448	5,808	**26,72,209**
Monthly Average	16,375	75.22	180	92.71	494	-8,077	18,621	484	2,22,684

- Although the average power factor is 92.71 % but still the University has paid Low PF Penalty of Rs 5,925/- during Dec 2021 to Nov 2022. However, this is due to the exceptionally low PF (72.81%) during Dec 2021, for which the imposed penalty was Rs.39,448/-
- The Time Of the Day (ToD) Rebate is Rs 96,922/- which is equivalent to Rs 18,621/- per month. This is appreciable and contributes directly in the reduction of Energy Bill.
- The Electricity Duty of Rs 2,23,448/- has been paid to State Govt during the year. This amount is 8.36% of the Electricity Bill.

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2.9 ELECTRICITY TARIFF:

The Power supply to the premises is fed on 3 Phase, 11 KV High Tension System by MP Madhya Kshetra Vidyut Vitaran Co. Ltd (MPMKVVCL) – the Discom. It is billed on HT Tariff 3.2 A, Non-Industrial tariff as per Tariff Order, passed by M.P. Electricity Regulatory Commission (MPERC).

The tariffs for different categories for the year 2022-23 (as per MP Electricity Regulatory Commission (MPERC) Bhopal, Order dtd 31.03.2022) are as below:

Category	Tariff No.	Monthly Fixed Charges (On Billing Demand)	Energy Charge (For Load Factor below 50%)	Energy Charge (For Load Factor above 50 %)
		Rs / KVA	Rs / Unit	Rs / Unit
Non-Industrial, 11 KV	HV 3.2 A	337	7.55	6.65

Annual Minimum Consumption (KWh) per KVA of Contract Demand is 600 Units.

For 200 KVA Contract Demand, it is 1,20,000 Units. The annual consumption of BOU is 2,26,480 Units. So, no excess on minimum consumption is being paid.

9.1 Power Factor:

Power Factor	Percentage incentive payable on billed energy charges
Above 95 % and Below 96 %	1%
Above 96 % and Below 97 %	2%
Above 97 % and Below 98 %	3%
Above 98 % and Below 99 %	5%
Above 99%	7%
Above 90 % and Below 95 %	Nil
Power Factor	**Percentage Surcharge payable on billed energy charges**
Below 90 % and Above 85 %	5%
Below 85 % and above 70 %	5 % + 2 % additional on each one percent fall below 85 %, subjected to maximum of 35%
Below 70 %	MP MK VV CL reserves the right to disconnect the Power Supply, till steps are taken to improve PF

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9.2 Time Of the Day (ToD) Tariff:

Peak / Off Peak Period	Surcharge / Rebate on Energy Charges
Months: April to October	
Normal Hours (i.e. Hours excluding Peak Load Hours)	**Normal Tariff**
Off Peak Hours (Between 10.00 PM to 6.00 AM Next day)	10 % Rebate
Months: November to March	
Normal Hours (i.e. Hours excluding Peak Load Hours)	Normal Tariff
Off Peak Hours (Between 10.00 PM to 6.00 AM Next day)	20 % Rebate

9.3 Specific Terms and Conditions of Tariff:

- Billing Demand in case of Demand Based Tariff should be actual demand or 90% of the Contract Demand, whichever is higher.
- Fixed charges for Excess Demand over and above the 120 % to 130 % of contract demand shall be charged at 1.3 times the normal fixed charges. Fixed charges for Excess Demand over and above the 130 % of contract demand shall be charged at 1.3 times the normal fixed charges for up to 120% to 130% and 2 Times for above 130%
- No extra charges are applicable on the energy charges due to the excess demand.
- Rebate of 1% on advance payments. Rebate of 0.5% on 'On Line' Payment, subjected to maximum of Rs.1,000/- and Rebate of 0.25% on Prompt Payment i.e. more than 7 days before the due date
- Surcharge at the rate of 1.25 % per month or part thereof on the amount outstanding (including arrears) will be payable if the bills are not paid up to due date.
- In case the cheque(s) presented by the consumer are dishonoured, a service charge at the rate of Rs. 1000/- plus applicable GST per cheque shall be levied in addition to delayed payment surcharge as per rules.
- No Metering Charges shall be levied
- **Green Energy Tariff of Rs. 1.13/ kWh, which is over and above the normal tariff of the respective category as per this Tariff Order, be levied to consumers opting for meeting their demand by 100% Renewable Energy from Distribution Licensee.**

Chapter 3: Major Observations

From Energy Audit point of view, there are no major concerns because there are no heavy electrical loads / machineries installed in the premises. The premises is operating on very low average annual Load Factor of 11%. The Billing Demand is just 75 KVA against Contract Demand of 200 KVA.

The record keeping of Bills and Records is very good except for the DG set generating units and diesel consumption

The premises already have LEDs installed for its Administrative Building, Class Rooms, Offices & Street Lights. This is a very good step towards energy conservation and hence reduction in electricity bills.

The premises has 100 KW Solar Plant operating, which indicates the University concern for Green Energy and reduction in Carbon Foot prints. This is appreciable.

However, there are some concerns as regards to Electrical Safety norms in terms of improper earthing and non-availability of safety mattings and Personal Protection Equipment (PPE) before main LT panels and DG set.

The regular annual visit of Engineer from Electrical Inspectorate, GoMP is not made in last 3 years. And the Electricity Duty on Units generated by DG sets are not paid to State Govt.

3.1 Power Supply Parameters:

The voltage between the Phase to Phase and Phase to earth are measured at all the electric Panels and are found to be in permissible range of 400 to 400 Volts for Line and 215 to 240 Volts for Phase.

All the electric panels and DG set panels have separate earth pits. The voltage between phase and earth and between neutral and earth is checked at every panel and is found satisfactory, within permissible limits.

Outdoor LT Capacitor Bank of 150 KVAr is installed at both the substation, with the capacitor combinations as below:

5 KVar – 3 No.

10 KVAr – 5 No.

15 KVAr – 3 No.

20 KVAr – 2 No.

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3.2 Major observations of the Audit team during inspection:

a. There is grass and vegetation in the substation / below transformer – It should be cut regularly, and the SS ground should be clear, free from garbage and properly covered with stone gitti.
The earth pit pipe is also seen. The Earth pits should be properly framed from the top with regular watering. Presently the earth pit pipes are open.

b. **The Main Panel Box of Transformer 2 has burnt out Cables. It should be immediately get maintained and replaced as per requirement. It may cause Power Outage at any time. Since there is very less load on transformer, it seems that burning of cables may be due to lose connection or unbalancing of the load. The same may be looked in to.**

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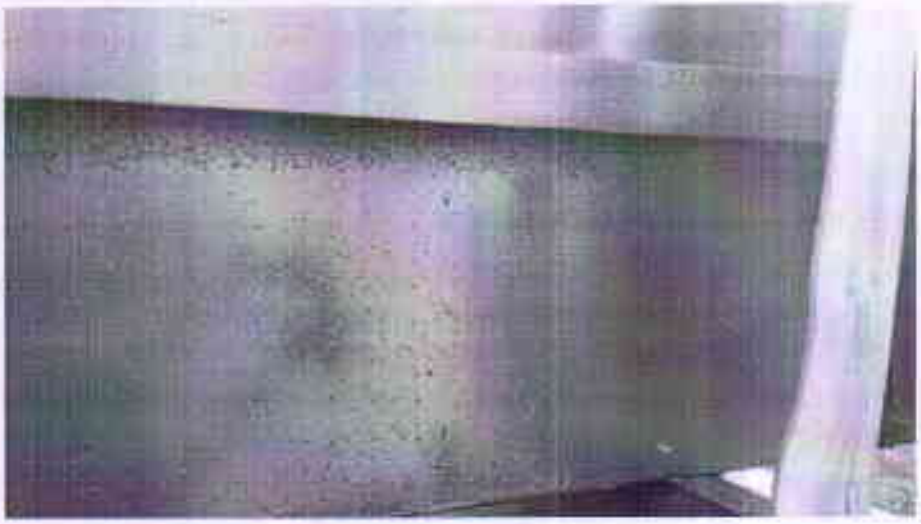
c. There is leakage of oil from both the Transformer tanks and the tanks have very low oil level. The Oil level in the conservator should be maintained as per desired level. If required, the oil top up may be done with due filtration of oil.



d. There is lot of dirt and dust over the solar panels. This reduces the efficiency of Solar Plant. It should be cleaned on daily basis.

e. The Lightning Arrestors, fitted on the Double Pole (DP) structure of (both the) Transformer are either damaged or missing out. The same should be installed immediately. Otherwise, any lightning stroke falling on the 11 KV feeder may cause the transformer damage.

f. Silica gel in the breather of both the Transformer breather needs drying up and top up or replacement.

g. There are no sleeves on 11 KV Jumpers connecting to Transformer. Since the clearance of these jumpers with earth is very low, non – sleeving is like an electrical hazard.

h. There is no approach road to Sub Station No. 1

i. The Log record of Units generated by DG set is not maintained. Nor the diesel consumption record is maintained. Without these records the DG set efficiency, fuel consumption and the cost of Unit power generation from DG set could not be ascertained. However, the running hours of DG set and Diesel purchase record is properly maintained.

j. The Electricity Duty on units generated by DG set is not being paid to State Government. It would attract penalty from MP Electrical Inspectorate.

k. There are no Single Line Diagram, no safety charts and no first aid charts for electrical shock in the main electric panel room and DG panel room.

l. At some panels like Material Store Panel, the earth wire from earth pit is found broken. At no places the armour of the cable is found connected to electric panel and is loss of opportunity to use an additional earth protection by way of cable armouring. The cable Armor should be used as an alternate earth.

m. The switch Boards needs to be checked for proper earthing and shall be redone wherever required.

n. Though the exact counting of Lighting fixtures is not made but it is observed that still some 40 % of the Lighting of official campus have Tube Lights. These tube lights consume more power than what Lumen they deliver, in comparison to other lighting elements like CFLs and LEDs. Similarly, around 40 No. Street Light fixtures have 150-Watt Sodium Vapour Lamp. Presently there are more energy efficient street lightings are available in the form of LED.

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Chapter 4: Recommendations, Cost Estimates and Funding

Based on field inspection, review of electricity bills and the observations of Audit team, there are some recommendations for the management of the college.

The major recommendations are as below:

4.1 Reduction in Contract demand with MP MK VV CL:

The Average Monthly Demand is just 75 KVA against Contract Demand of 220 KVA. The maximum Demand has reached only up to 102 KVA in the month of May 2022 (Peak summer period) and only thrice more in one year, it has crossed 90 KVA.

The Load factor of the premises is also very low and is just 11%

It is recommended that the Contract Demand of the connection (with MP MK VV CL) be reduced to 80 KVA only from 200 KVA.

This would result in gross reduction of Electricity Bill, on account of reduction in Fixed Charges. The Fixed Charges are billed at the @ Rs 337 / KVA.

With this reduction of 120 KVA (=200 – 80), there would be **monthly saving of:**

120 X 337 = Rs. 40,400/- per Month ~ Rs 4,84,800 per annum

This saving is sufficient to adopt energy conservation, energy efficiency and electrical safety measures and also to pay the fee of seeking time to time advise of Energy Auditor or Energy Advisor on regular basis.

4.2 Audit and upkeep of Solar Plant:

It is seen that the 100 KW solar plant Annual Generation of Electricity is 29,986 Units which is equivalent to 2,499 **(2,500 Units)** Units per Month ~ 83 Units per Day.

As per thumb rule a Solar Plant should generate at least 4 Units a day per KW. With this rule there should be at least (100 X 4) 400 Units of Solar generated per day which is equivalent to **12,000 Units** per Month.

It is recommended that the Solar Panels be cleaned every day by the maintenance agency. This would result in to the most optimal utilisation of Solar Plant.

The average monthly consumption of the premises is 18,873 Units. This 12,000 Units of Solar Generation, would be directly subtracted from the Units consumed from the Grid.

This means there would be monthly reduction in billed units as **12,000 – 2,500 = 9,500 Units**

The average rate of electricity as per electricity bills of Dec 2021 to Nov 2022 is Rs 16.12 per Unit.

This means there would be a net monthly saving of Rs 16.12 X 9,500 Units = Rs.1,53,140/- or Annual saving of Rs.18,37,680 /-

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4.3 OTHER RECOMMENDATIONS:

i. There should be interconnection arrangement at LT level between the two Distribution Transformers, to increase the reliability of Power supply. In case of annual maintenance or repair works, the entire load may be transferred on one transformer. The capacity of each transformer (315 KVA) is sufficient to cater the full load of the premises.

It is proposed to lay a 3-1/2 core 300 sqmm Cable connecting the main electric panel of both the transformers. There would be 400 Amp MCB at both the ends and in between. The MCB between the two panels shall remain open and when one transformer is under outage, that MCB may be switched on to cater the load through the other transformer. This whole arrangement shall be outdoor and may be housed in any of the substation.

ii. All Substation / Transformer equipment (Lightning Arrestors, Switches, Silica Gel etc.) should be properly installed and maintained in healthy and operational condition.

iii. Transformer DP and Distribution Box should be maintained by an authorised person or agency. Top Up of Transformer oil and silica gel with due filtration of transformer oil is required.

iv. Sub Station earthing pit should be casted and watered regularly

v. Sub-station grass should be regularly cut and cleaned by an authorised person.

vi. Proper Log of units generated by DG set should be maintained in a register /log book, to be maintained by the DG Operator / Electrician. The Energy Meter Reading should be noted every time the DG set is put in operation and the units generated at that tenure be mentioned in that log book. Or alternatively, Energy Meter Reading on month – to month basis may also be maintained.

A similar log of diesel consumption should also be maintained on month-to month basis starting with opening stock of diesel in the DG set, quantity of top up during the month and the balance stock of diesel in DG Set.

This type of accounting is very essential for proper energy accounting and ascertaining the fuel consumption of DG set or otherwise to check if there is any misuse or pilferage of diesel.

vii. The cable armour should be firmly connected with main LT panels. Separate Earth pits to be provided for every Electric Panel and Distribution Board. Proper arrangement for regular watering of SS earthing pits should be made.

viii. Placement of CO2 Type fire extinguishers, Safety Mattings and PPE in main electric LT panel room and DG set Room.

ix. Power Factor of the premises should be regularly checked on monthly basis. If at any month the pf falls below 90%, this would indicate the failure of some of the capacitors from capacitor bank. This should immediately be attended and replaced, if required.

x. Non- essential loads like water pumps etc should be run during off peak hours preferably (between 10 pm to 6 am), to utilise the ToD tariff.

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xi. Existing Tube Light fittings in the University official buildings should be replaced by LED Lights or CFLs of appropriate rating / wattage. Similarly, the 150-Watt Sodium Vapour Lamps should be replaced by 80 Watt LED. The wattage of LED is proposed more because the street light poles are 11 m long.

xii. Proper maintenance of solar plant is required, which mainly involves daily cleaning of dust from the solar panels and replacement of faulty / damaged / broken panel. This would ensure the most optimal utilisation of Solar Plant.

xiii. Solar Energy Audit should be conducted at definite periodicity.

xiv. Energy Audit study should be conducted once in three years by BEE Certified and MPUVN empanelled Energy Auditors to give a real account of existing efficiency of energy usage. This also provides means to cross check the strategies which have been adopted in the previous year and facilitates in establishing a Cost Centre approach on the basis of records of specific energy consumption calculated for each activity separately.

xv. To enhance the awareness level of the students, employees and visitors and as well as to sensitize them, it is recommended to fix motivational and educational posters related to Energy saving and energy modesty at strategic locations like reception area, Library, gallery etc. Such posters will also help as a regular reminder to the students and teachers to use energy judiciously in the college as well as in their homes.

To start with 10 such posters may be posted. Each poster will cost about Rs.500/- only. Thus, the total investment will be only Rs.5,000/-.

4.4 Cost Estimates and Pay Back Period:

There are no major Capital-Intensive works proposed, but some medium Capital intensive are recommended for increasing the reliability of power supply and energy savings.

The work wise cost estimates and payback period are as below:

Estimated Budgetary Provision for the recommendations					
S. No.	Particular	Qty	Estimated Unit Rate (Rs)	Amount (Rs)	Periodicity
1	Upkeep of Substation and its Equipment (Breather, Silica gel, Lightning arrestors, Earth Pit framing, gitti laying etc	2	30,000	60,000	One Time and then on need base
2	Transformer Oil filtration and top up	2	30,000	60,000	
3	Safety equipment at SS Panel, and LT Main Panels, Safety Charts, SLD etc	LS		23,000	One Time
4	Watering arrangement for SS Earthing		Inhouse		Fortnightly

Estimated Budgetary Provision for the recommendations					
S. No.	Particular	Qty	Estimated Unit Rate (Rs)	Amount (Rs)	Periodicity
5	Separate earth pits for each building / block, and main Electric panels (where ever required)	5	15,000	75,000	One Time
6	Running of Earth wire at all the switch Boards and earth strip from earth pits	LS		50,000	One Time
7	Energy Efficiency and Electrical safety awareness Posters	10	500	5,000	One Time
8	Replacement of Tube Light elements by LED Lights	200	Refer to Annexure	90,000	**One Time Pay Back 7 Months**
9	Replacement of Sodium Vapour Lamps by 80 Watt LED	40	Refer to Annexure	52,000	**One Time Pay Back 3 Months**
10	Interconnection Provision between two Transformers	LS	Refer to Annexure	6,50,000	One Time
11	Miscellaneous	LS		1,00,000	Annual
	Total Capital Expenditure			**11,65,000**	
SAVINGS					
S. No.	**Particular**	**Qty**	**Estimated Unit Rate (Rs)**	**Annual Saving Amount (Rs)**	**Periodicity**
1	Reduction of Contract Demand From 200KVA to 80 KVA			4,85,000	One Time
2	Up Keep of Solar Power Plant			18,35,000	
	Total Annual Saving			**23,20,000**	
	PAY BACK PERIOD	**11,65,000 / 23,20,000**		**0.50**	**6 Months**

Total Investment (Mostly one Time) = Rs 11,65,000/-

Total Annual saving = Rs 23,20,000/-

Pay Back Period = 0.50 Years or 6 Months

The rates in the above table are estimated as per the present market rates. However, the exact budgetary provision to be made as per the actual market rate at the time of execution of works.

All the works shall be executed by respective authorised agency like 'A' Class electrical Contractor, 'B' Class electrical contractor under the supervision of skilled Electrical Engineer and licensed electrician.

4.5 Funding:

There are no major or Capital-intensive works proposed in the Report

There are some mid cost proposals of replacement of Tube Lights and Sodium Vapour Lamps, the funds for which may be easily met out from the savings proposed in the Report.

The cost for the interconnection arrangement between the two transformers is also a mid-cost capital intensive, but this investment is required for enhancing the Power Supply reliability in the campus and to increase the utilisation of Power assets.

The cost for the maintenance of substation, transformer and the Electric panels are routine maintenance costs and may be met out from the savings proposed in the Report.

Just there is need to make vigilant about the electrical installations and make timely follow ups with concerned department like MP MK VV CL, MP Electrical Inspectorate and electrical maintenance contractors.

Annexure Followed on Next Page

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ANNEXURE 1.1

Pay back Calculation Sheet for replacement of 200 Number 40 Watts Flouroscent Tube Lights (FTL) by 20 Watts LED Tube Lights												
Type	Qty	Power of each Unit	Burning Hrs / day	Diversity Factor	Electricity Consumption (KWh), 23 Days / Month			Electricity Tariff (Rs./ KWh) *	Annual Electricity Charges (Rs.)	Cost of 25 W LED TL (Rs.)	Unit Labour Charge for Replacement	Total Investment (Rs.)
		Watts	Hrs	%	Per Day	Monthly	Annual					
40 W Fluorescent Tube Light	200	60	8	0.6	58	1,325	15,898	16.12	2,56,269			
25 W LED TL	200	20	8	0.6	19	442	5,299	16.12	85,423			
Saving					38	883	10,598	16.12	1,70,846	400	50	90,000
					Pay Back Period				90,000 / 1,70,846	6.32	Months	

ANNEXURE 1.2

Pay back Calculation Sheet for replacement of 40 Number 150 Watts Sodium Vapour Lamps by 80 Watts LED Tube Lights												
Type	Qty	Power of each Unit	Burning Hrs / day	Diversity Factor	Electricity Consumption (KWh), 30 Days / Month			Electricity Tariff (Rs./ KWh) *	Annual Electricity Charges (Rs.)	Cost of 80 W LED TL (Rs.)	Unit Labour Charge for Replacement	Total Investment (Rs.)
		Watts	Hrs	%	Per Day	Monthly	Annual					
Sodium Vapour Lamp	40	200	10	1.0	80	2,400	28,800	16.12	4,64,256			
80 W LED TL	40	80	10	1.0	32	960	11,520	16.12	1,85,702			
Saving					48	1,440	17,280	16.12	2,78,554	1000	300	52,000
					Pay Back Period				52000 / 278554	2.24	Months	

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ANNEXURE 1.3

Estimated Cost For providing Interconnection between two Transformers:

Estimated Cost of Laying of Under Ground Cable LT 300 sq mm 3-1/2 Core, armoured, in pipe for a route length of around 400 m

- Cable Cost = Rs. 5,00,000/-
- Labour Cost = Rs 50,000/-
- LT MCB 400 Amp = 40,000/-
- Panel and Civil Work = 40,000/-
- Miscellaneous items = 20,000/-
- **Total = Rs 6,50,000/-**

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END OF REPORT

मध्यप्रदेश भोज (मुक्त) विश्वविद्यालय
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क्रमांक/ /यां. शा./म.प्र.भो.मु.वि.वि./ भोपाल, दिनाँक

प्रति,

प्रबन्ध निदेशक,
पर्यावरण नियोजन एवं समन्वय संगठन,
(मध्य प्रदेश शासन की स्वशासी संस्था)
पर्यावरण (परिसर, ई–5 सेक्टर अरेरा कॉलोनी
भोपाल (म0प्र0)

विषयः–म0 प्र0 भोज (मुक्त) विश्वविद्यालय परिसर की ग्रीन ऑडिट करने बाबत् ।

महोदय,

उपरोक्त विषयांतर्गत लेख है कि म0 प्र0 भोज (मुक्त) विश्वविद्यालय परिसर की ग्रीन ऑडिट किया जाना है। कृपया ग्रीन ऑडिट हेतु परिसर का निरीक्षण कर होने वाले व्यय का विस्तृत विवरण सहित प्राक्कलन अधोहस्ताक्षरकर्ता को अतिशीघ्र उपलब्ध करवाने का कष्ट करें जिससे कि विश्वविद्यालय की ग्रीन ऑडिट का कार्य अति शीघ्र संपन्न कराया जा सके।

आदेशानुसार

कुलसचिव

क्रमांक/7869/यां. शा./म.प्र.भो.मु.वि.वि./ भोपाल, दिनाँक 04/01/23

प्रतिलिपि–

1. माननीय कुलपति जी के निज सचिव के माध्यम से सूचनार्थ।
2. वित्त नियंत्रक, म0 प्र0 भोज मुक्त विश्वविद्यालय।
3. सहायक संचालक, आवासीय संपरीक्षा म0 प्र0 भोज मुक्त विश्वविद्यालय।

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